Balancing the Environment and Economic Objectives of Energy Policy: South Korea's Perspective

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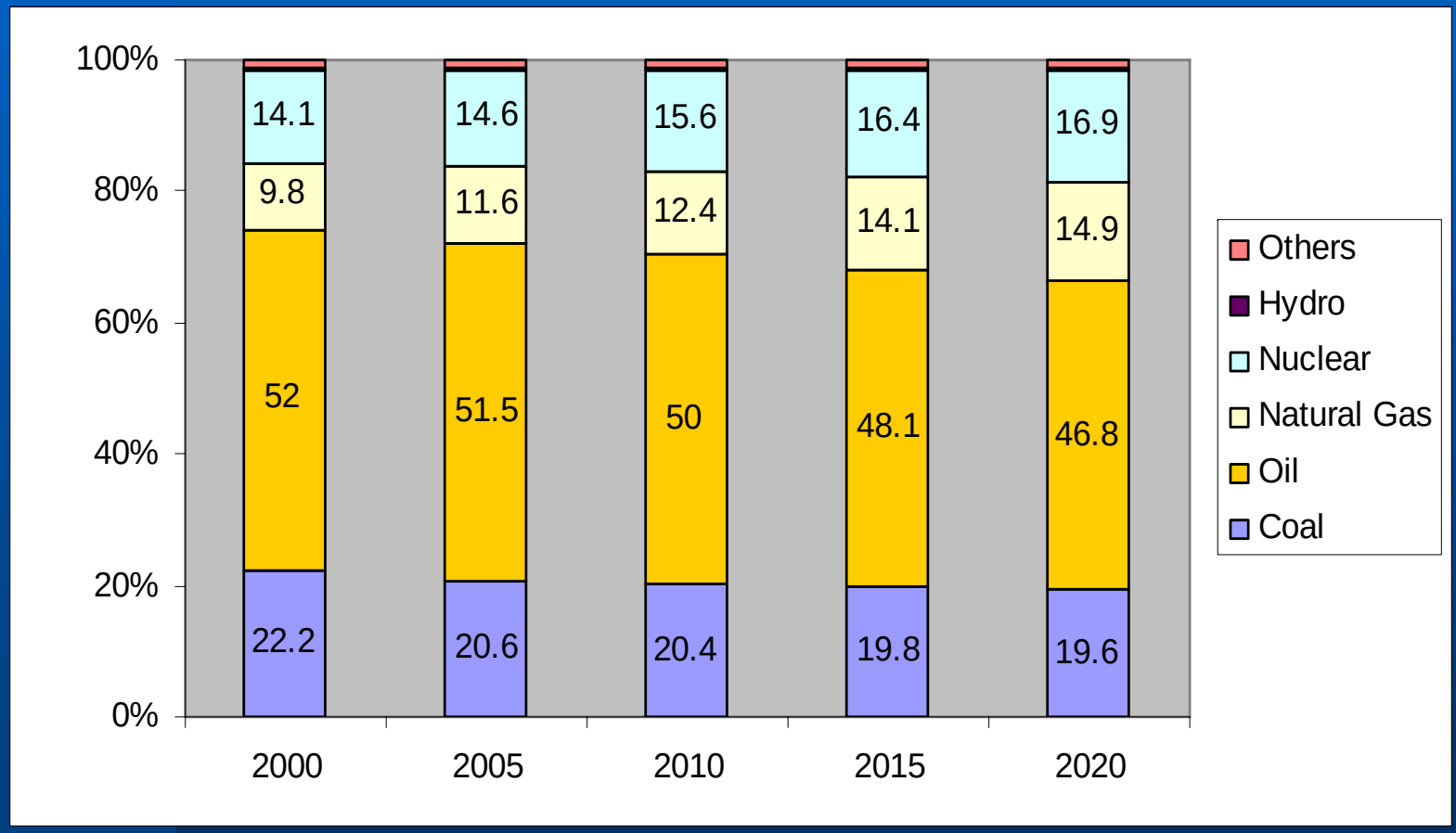
Changes in Korea's Energy Scene (Primary Energy Shares)



External Shocks --> Energy Modernization

- **First Oil Crisis (1973)**
  - **Nuclear power generation system**
  - **Steam coal power generation**
- **Second Oil Crisis (1979)**
  - **Natural gas imports**
- **Next Energy Crisis (?)**
  - **Energy efficiency technology**
  - **New & Renewable energy tech**

Changes in Korea's Energy Scene (Primary Energy Demand)

(million toe)

	2000	2005	2010	2015	2020	Growth Rate (%)		
						00-10	10-20	00-20
Coal	42.9	48.7	56.0	60.7	65.6	2.7	1.6	2.1
Oil	100.3	121.3	137.6	147.6	156.5	3.2	1.3	2.2
Natural Gas	18.9	27.3	34.2	43.4	49.8	6.1	3.8	5.0
Hydro	1.4	1.2	1.1	1.2	1.3	-2.4	1.4	-0.4
Nuclear	27.2	34.4	42.9	50.4	56.4	4.7	2.8	3.7
Others	2.1	2.8	3.2	3.8	4.5	4.3	3.5	3.9
Total	192.9	235.8	275.1	307.1	334.2	3.6	2.0	2.8

Changes in Korea's Energy Scene (Long-term Projection)

	2000	2005	2010	2015	2020	Growth Rate (%)		
						00-10	10-20	00-20
GDP (trill '95 Won)	476.3	622.3	794.2	985.0	1,198.4	5.2	4.2	4.7
Population (mill persons)	47.3	49.1	50.6	51.7	52.4	0.7	0.3	0.5
Total Energy (mill toe)	192.9	235.8	275.1	307.1	334.2	3.6	2.0	2.8
Energy per Capita (toe/person)	4.08	4.80	5.43	5.92	6.38	2.9	1.6	2.3
Energy/GDP (toe/mill '95 Won)	0.40	0.38	0.35	0.31	0.28	-1.6	-2.1	-1.8
GDP Elasticity of Energy	-	0.70	0.63	0.51	0.43	(0.69)	(0.47)	(0.60)
Final Energy (mill toe)	150.1	182.8	209.1	231.7	250.0	3.4	1.8	2.6

Vulnerabilities

- Supply security
- Environmental integrity
- System inflexibility from technology lock-in

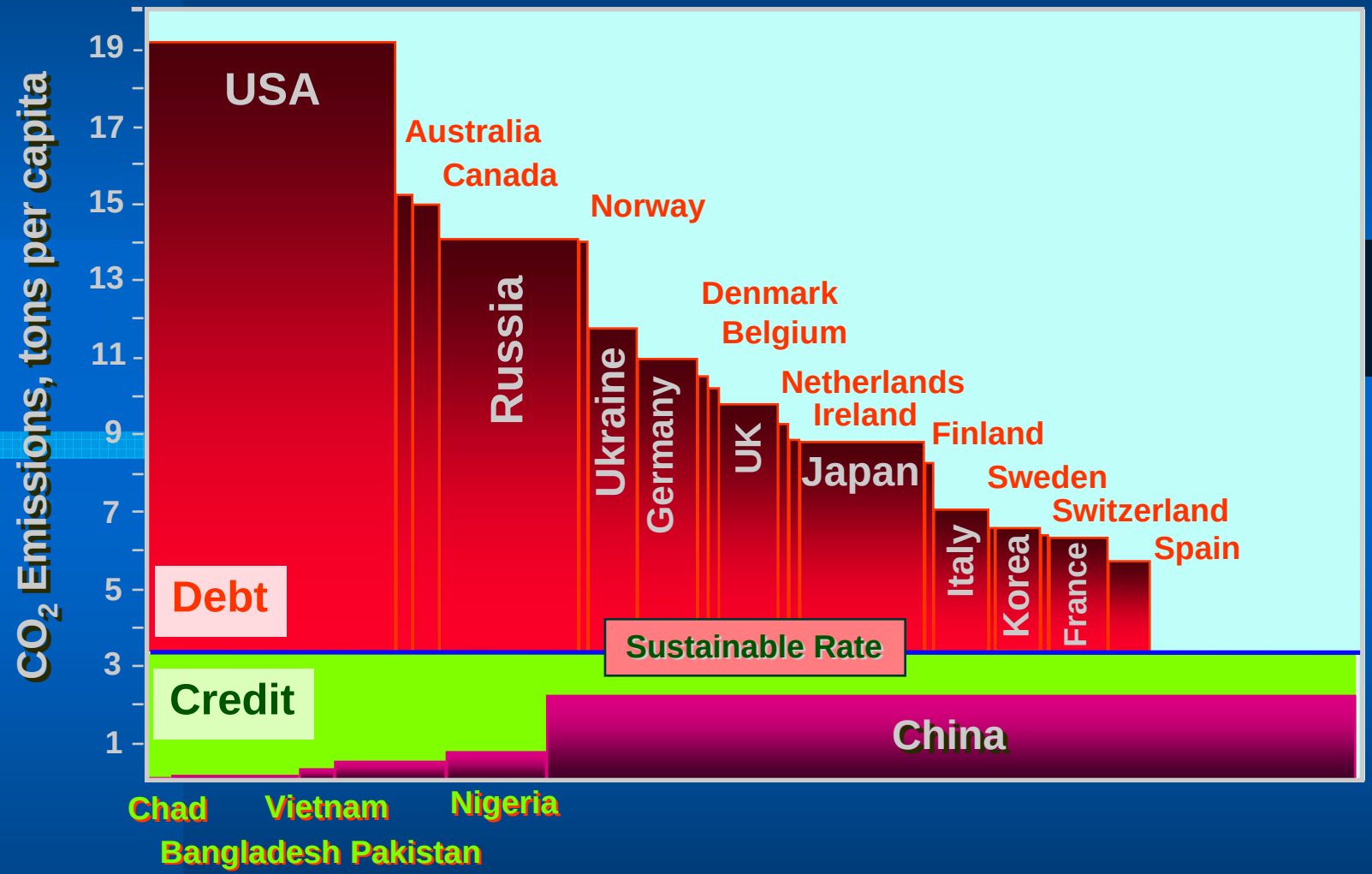
System Inflexibility

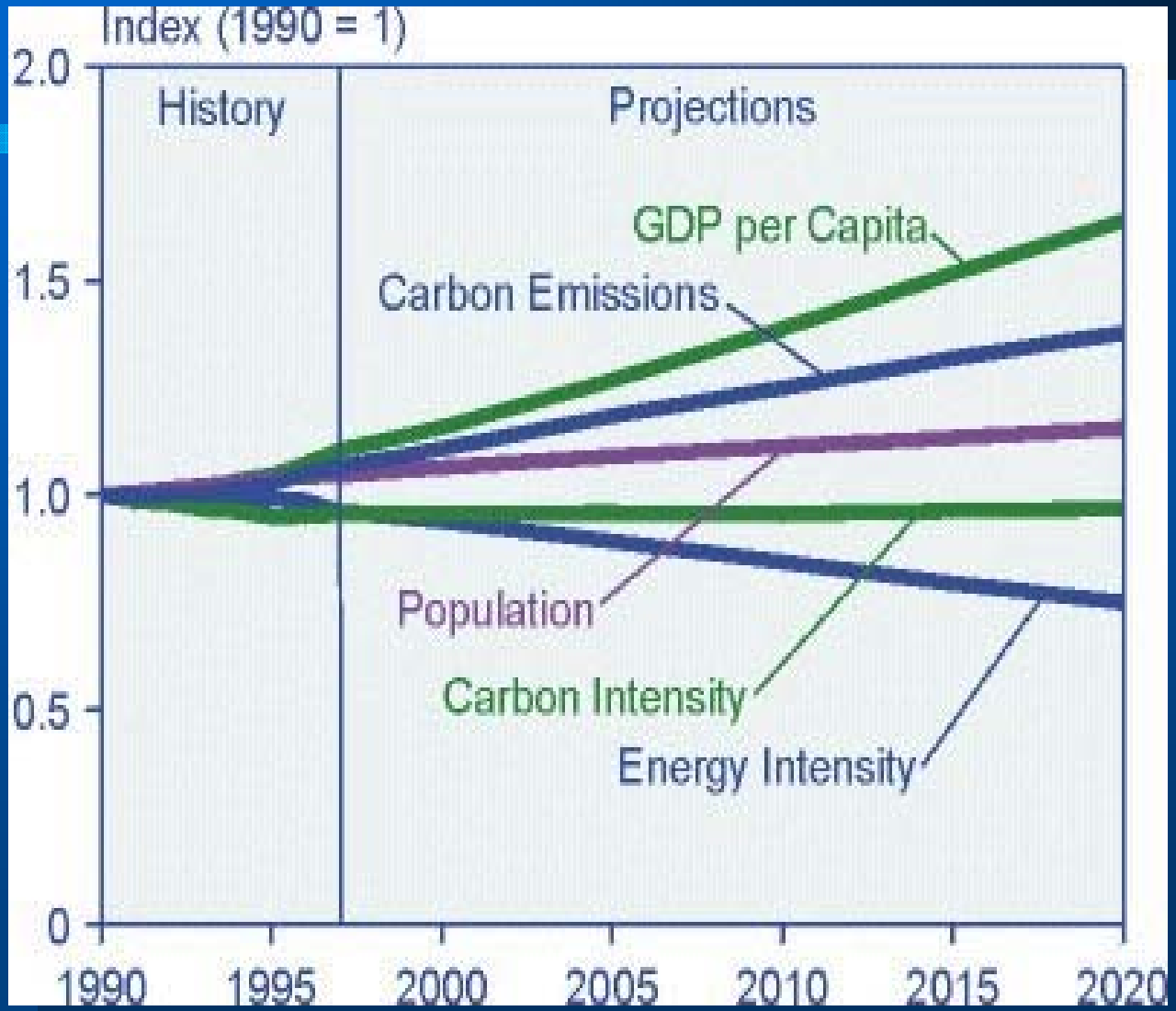
- Nuclear investment is exogenous to the system
- State dominance in electricity and gas
- Competitive disadvantage for new technology: energy efficiency improvement, new and renewable energy sources

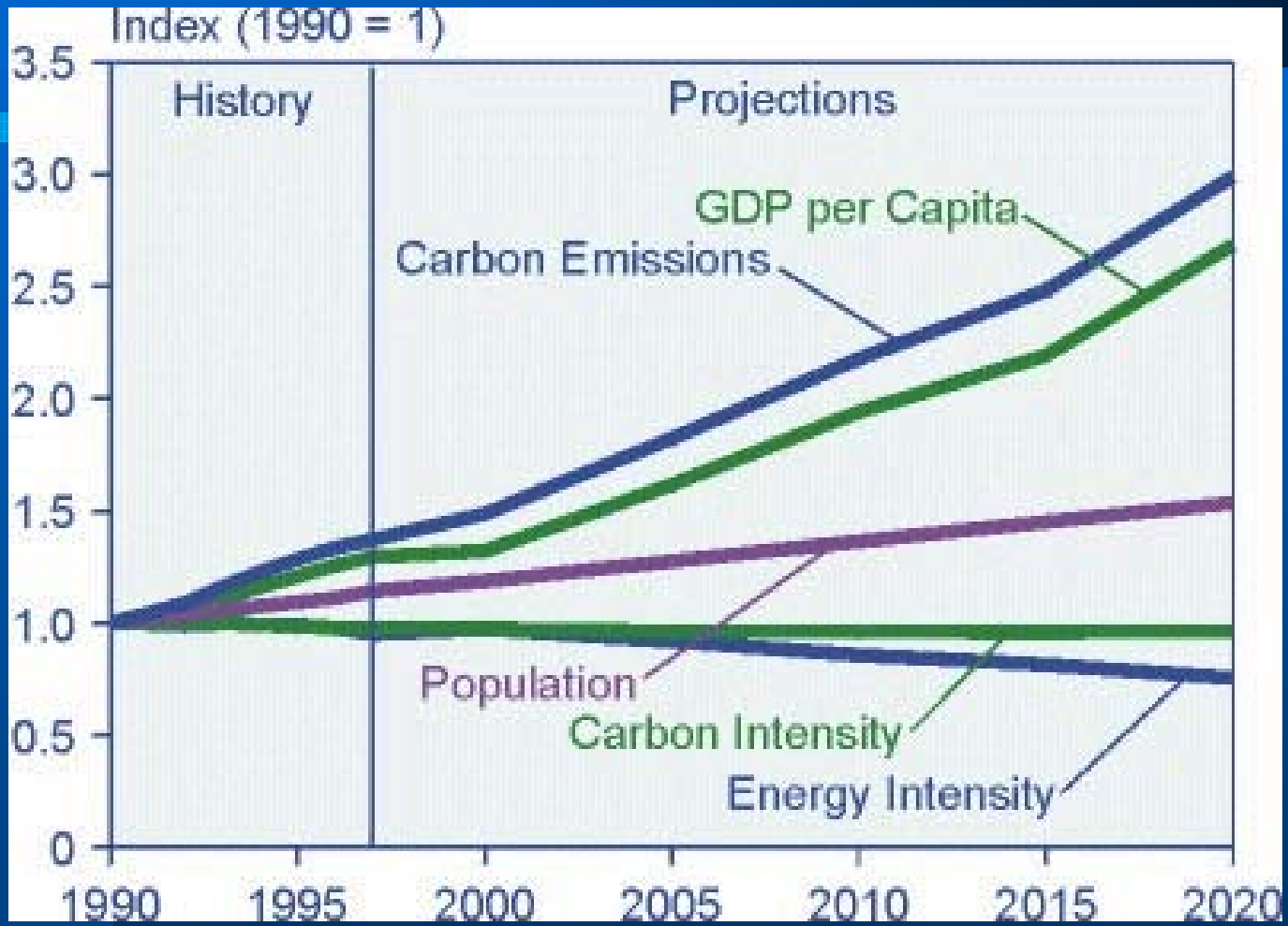
OECD Sustainable Energy Scenario 2020 vs Korea

	Korea		NA	WE
Coal	20 %	>	12 %	11 %
Oil	47	>	27	28
Natural Gas	15	<	26	24
Nuclear	17		9	17
Hydro	-		7	9
New, others	1	<	19	11
Total	100		100	100

CO_2 Emissions per Capita




Index (1990 = 1)
2.0
1.5
1.0
0.5
0
History
Projections
GDP per Capita
Carbon Emissions
Population
Carbon Intensity
Energy Intensity
1990
1995
2000
2005
2010
2015
2020


Index (1990 = 1)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
History
Projections
GDP per Capita
Carbon Emissions
Population
Carbon Intensity
Energy Intensity
1990
1995
2000
2005
2010
2015
2020

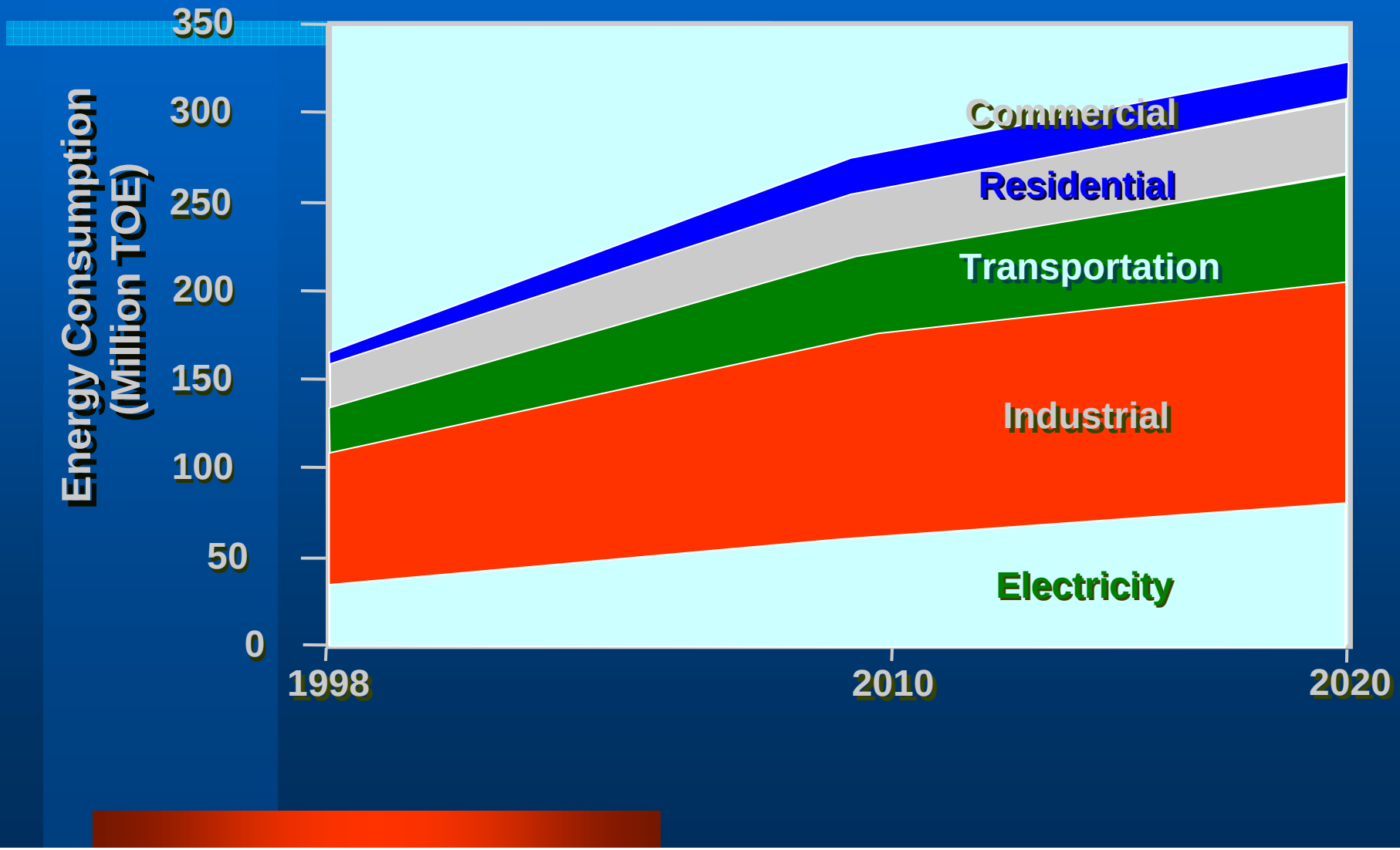
Components for CO2 Emissions

	1997--2010		2010--2020	
	OECD	LDC	OECD	LDC
Carbon Intensity %	0.0	-0.1	0.1	0.0
Energy Intensity %	-1.0	-0.8	-1.2	-1.3
GDP per capita %	1.8	3.2	1.7	3.3
Population %	0.5	1.4	0.4	1.2
CO2 emission %	1.2	3.6	1.0	3.2

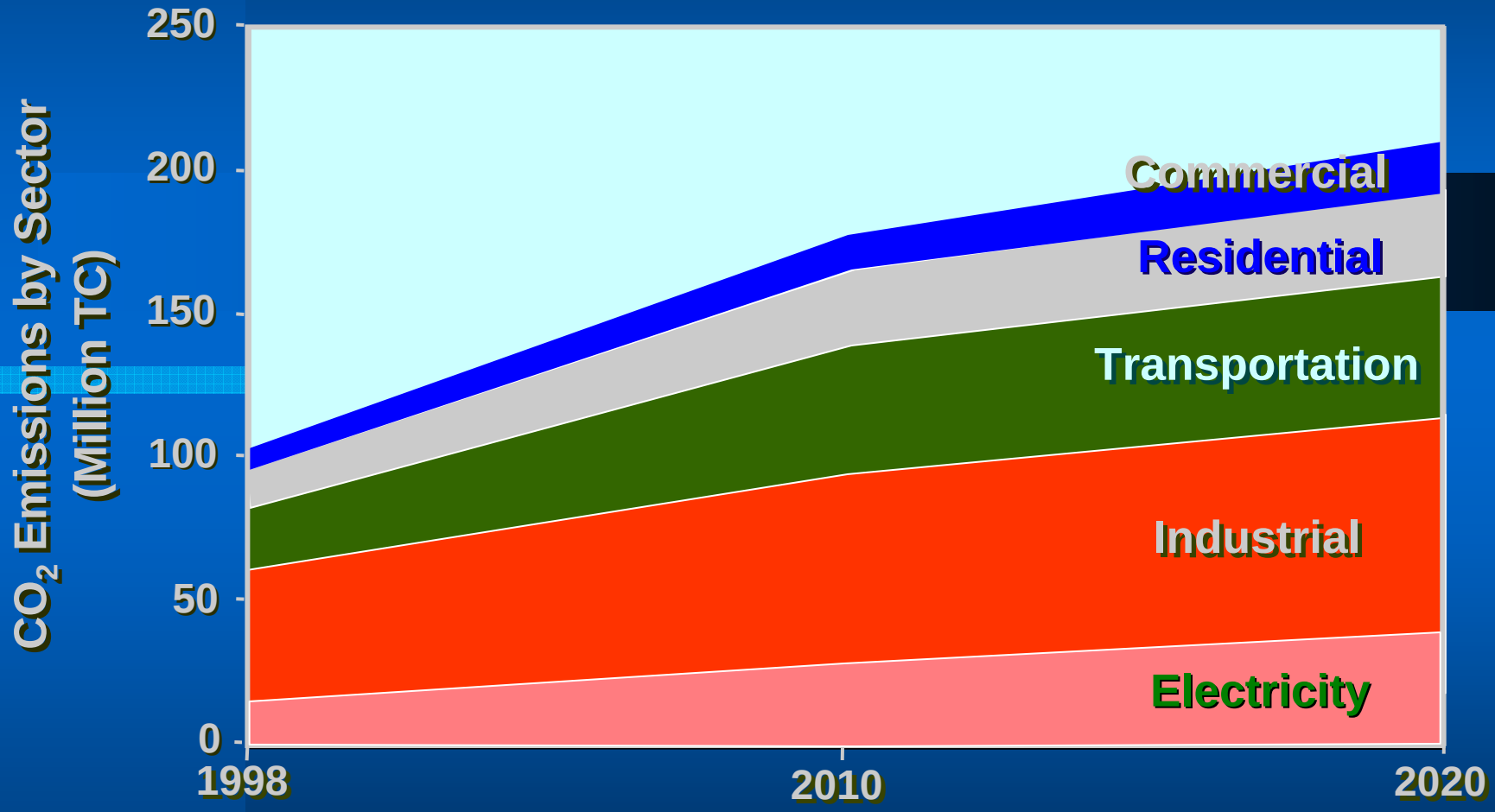
Cost-Effectiveness Tests

- **Industrial Sector :**
  - Payback period : Average = 1.23 years; maximum of 7 years (less than one-tenth of 1% of cases involve 7-year paybacks)
- **Transportation Sector :**
  - Payback Period < 5 years
- **Residential and Commercial Sector:**
  - Cost of Conserved Energy (CCE) < 5.0 cents/kWh (60 Won/kWh)

South Korea's Energy Consumption in 2020: MOCIE/KEEI BAU Forecast



South Korea's CO_2 Emissions in 2020:
MOCIE/KEEI BAU Forecast



Korea Industrial Sector Scenario
Measures Selection

Facility Assessments screened by:

- SIC Codes of Korean industries
  - Energy Intensive Industries: Primary Metal, Cement, and Petrochemical
  - Non-Energy Intensive Industries (e.g., textiles, machinery, etc.)

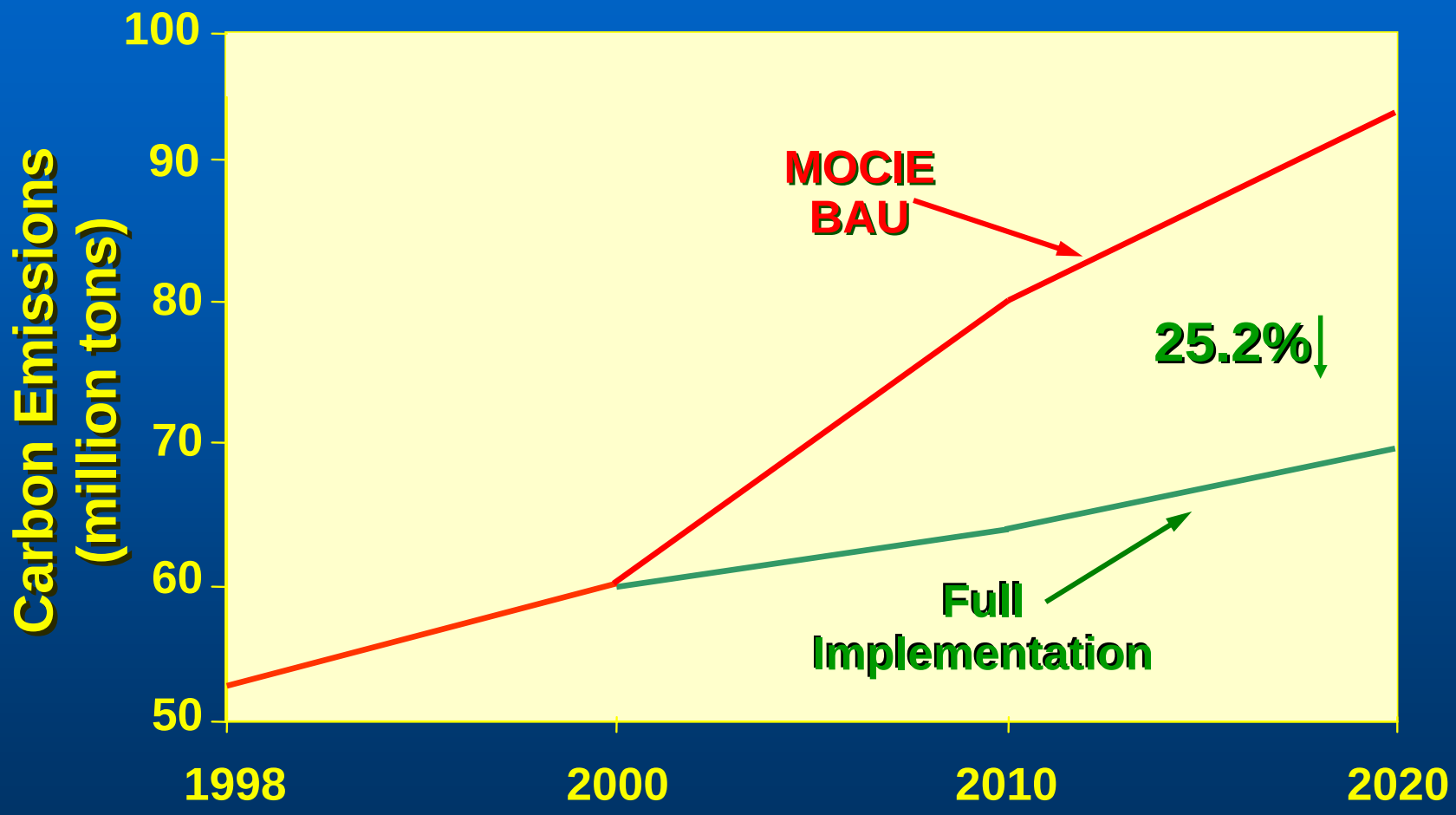
Technologies screened by:

- Energy efficiency measures only
- Technology packages that contributes at least 10% energy savings at a typical facility

Cost-Effectiveness Test:

- Payback period : Average = 1.23 years; Maximum = 7 years

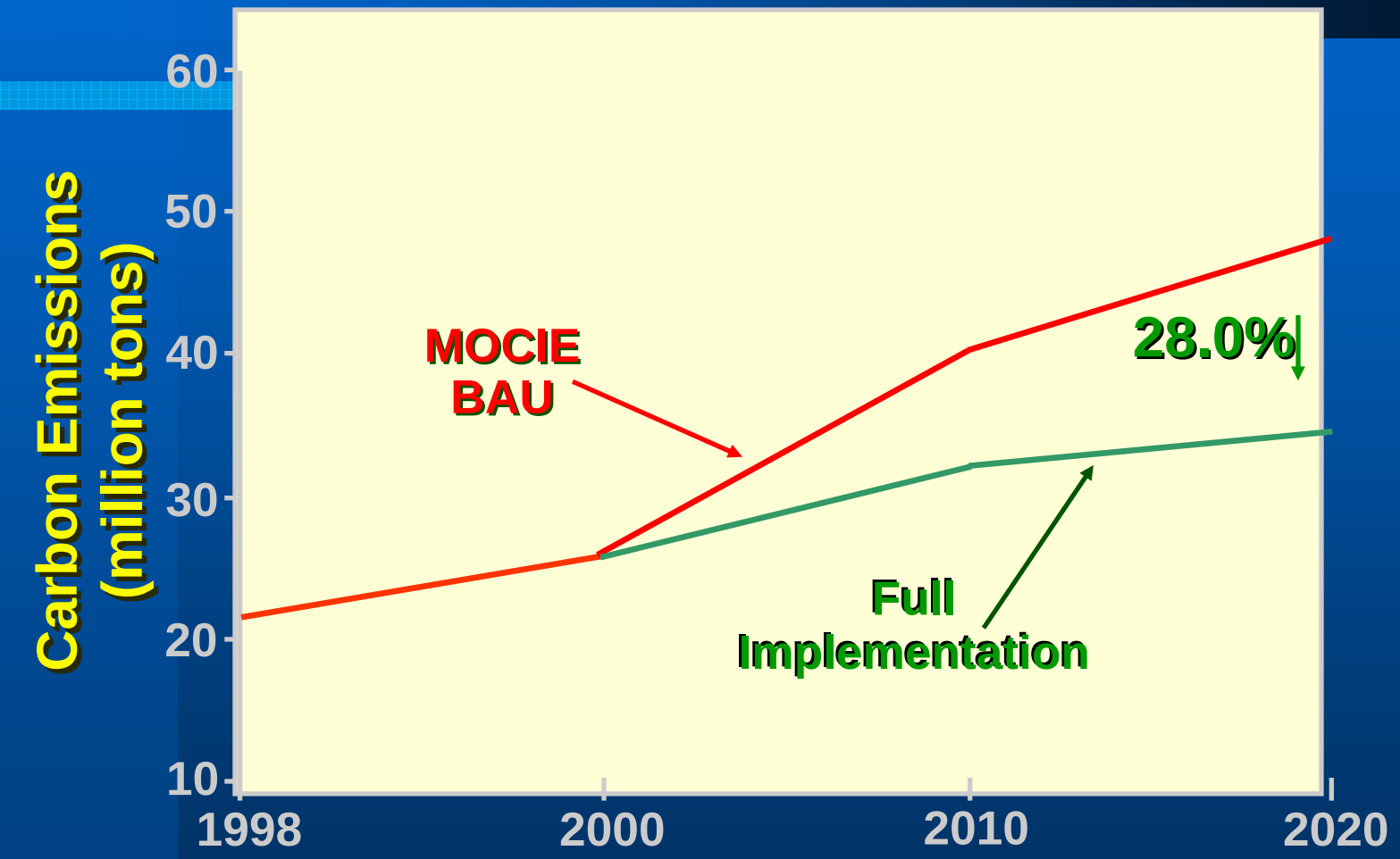
Korea Industrial Sector Scenario



Korea Transportation Sector Scenario Measures Selection

- **Target Technologies**
  - Fuel Economy Improvement Technologies
  - Alternative Fuel Vehicles
- **Cost-Effectiveness Test:**
  - Payback Period < 5 years

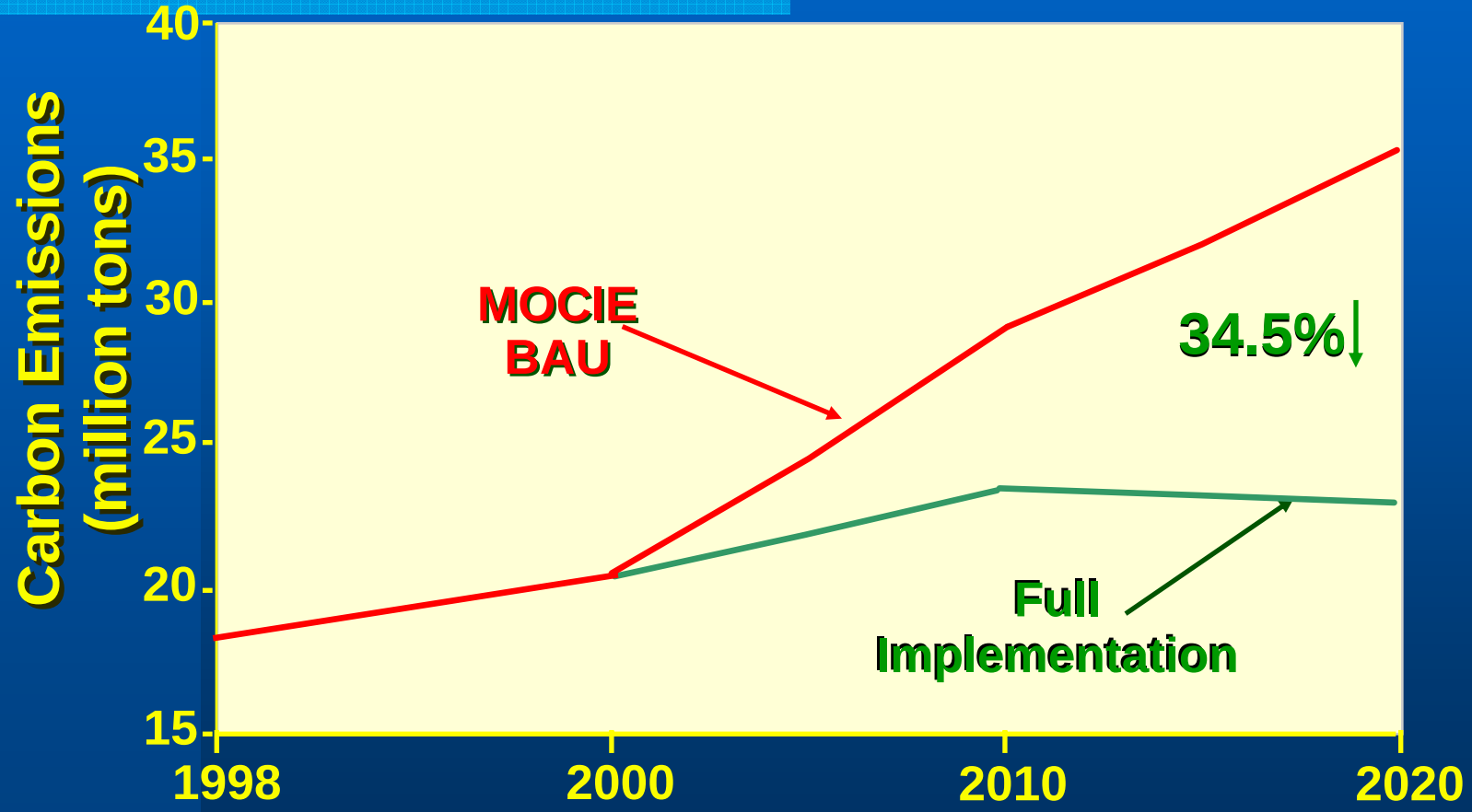
Korea Transportation Sector Scenario



Korea Residential Sector Scenario Measures Selection

- **Target Technologies**
  - Space Heating and Cooling Upgrades
  - High Efficiency Lighting
  - Refrigeration
  - Shell Insulation
- **Cost-Effectiveness Test:**
  - Cost of Conserved Energy (CCE) < 5.0 cents/kWh (60 Won/kWh)

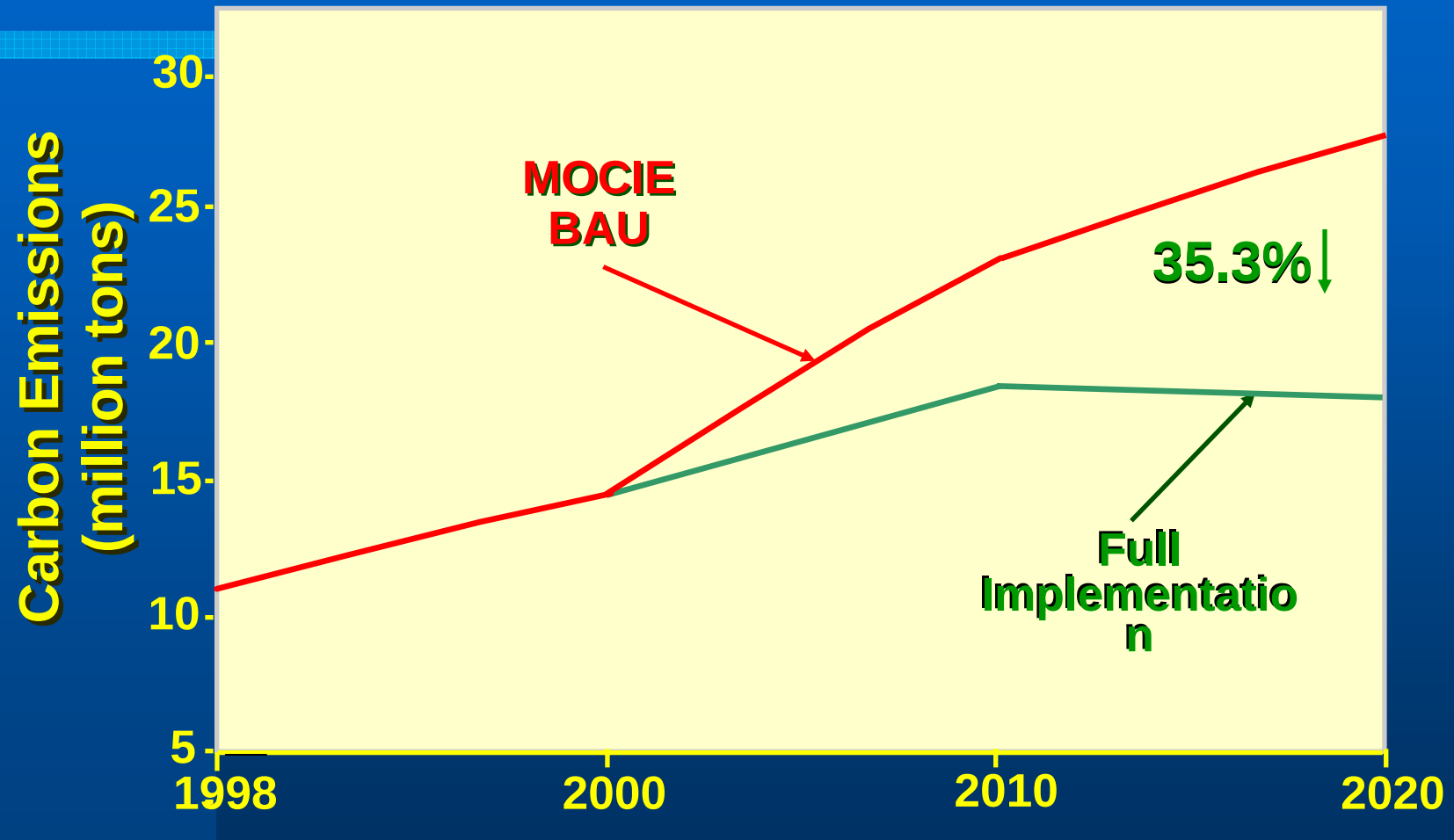
Korea Residential Sector Scenario
Three Implementation Options



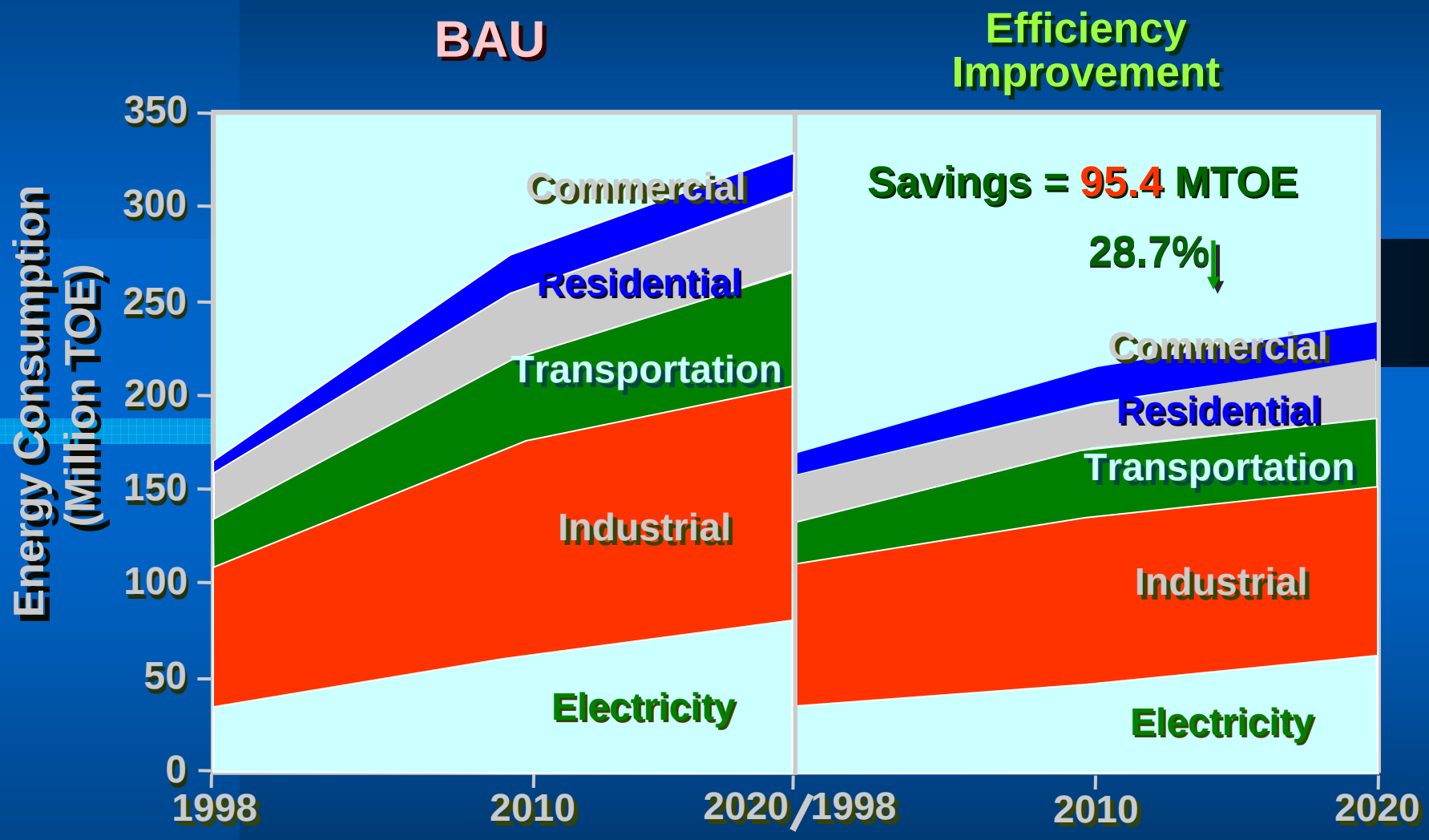
Korea Commercial Sector Scenario
Measures Selection

- **Target Technologies**
  - High-Efficiency Lighting
  - Space Heating and Cooling Upgrades
  - Motors (for air circulation, elevators, etc.)
  - Shell Insulation
- **Cost-Effectiveness Test:**
  - Cost of Conserved Energy (CCE) < 5.0 cents/kWh

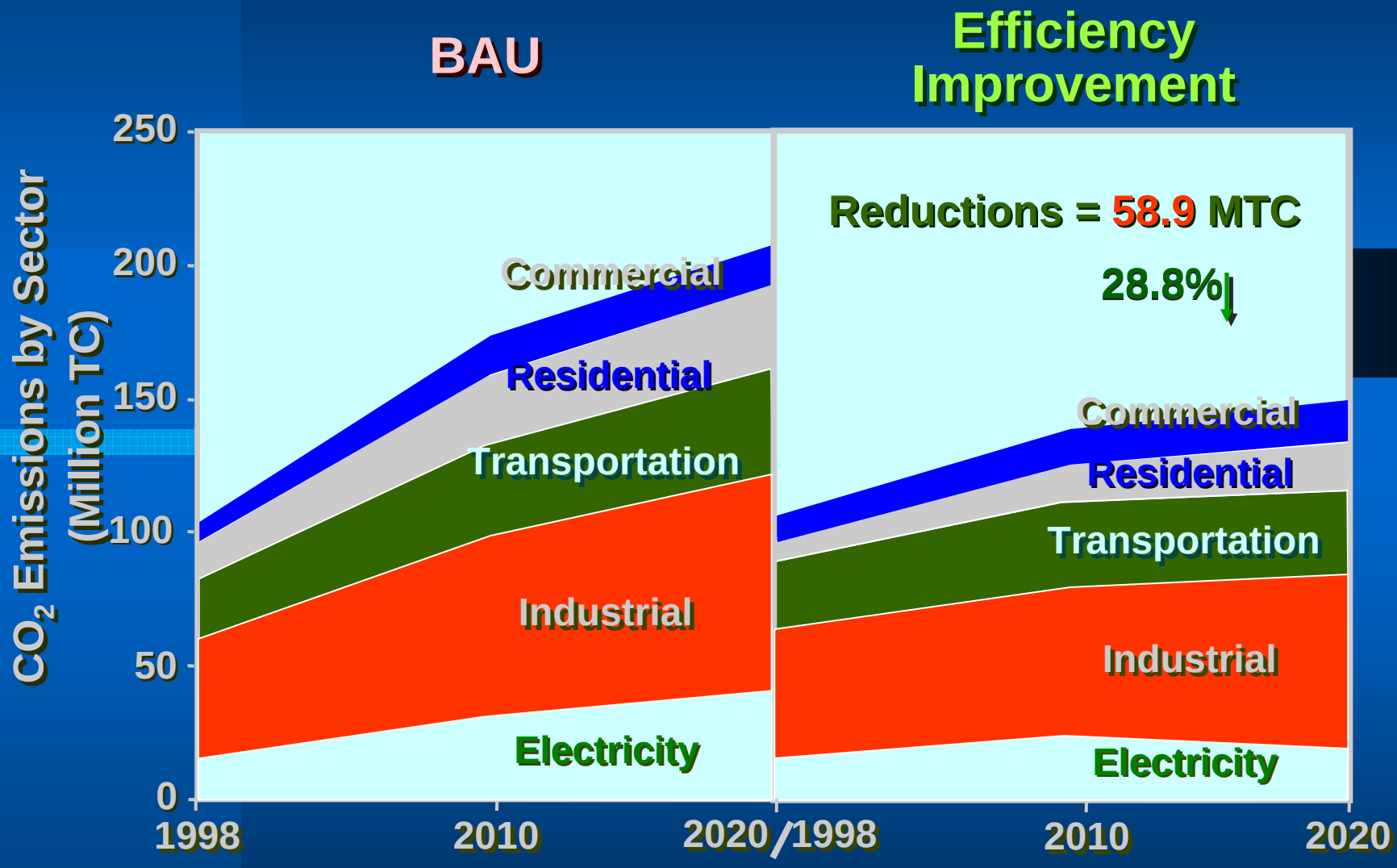
Korea Commercial Sector Scenario



South Korea's Energy Consumption in 2020



South Korea's CO_2 Emissions in 2020



Conclusion: Cost Effective Sustainable Energy Development is Possible

- Electricity saved total (34 mtoe) > Nuclear capacity planned (30 mtoe) for 2000-2020
- Benefits of energy saved ($30 B) > Costs of efficiency improvement ($4 B) for 2000- 2020
- Create level playing field for efficiency upgrades technology and new & renewable energy resources
- Avoid further lock-in of old technologies
- Utilize the window of opportunities: Intensify energy R&D, technology diffusion

Developments in LNG Market

- **Upstream costs down**
  - **Funding method**
  - **Competition in EPC**
  - **Increased scale and design efficiency of liquefaction**
  - **Shorter development period**
  - **Early project commitment with flexible terms**
- **LNG Shipping**
  - **27 to 44 uncommitted ships by 2005**
  - **Bigger ship size: 165,000m^3, lower unit building costs**
  - **Weaker destination restriction**
  - **Amenable to short-term LNG trading and internal competition**

Developments in LNG Market

- **Changing LNG Acquisition Practice**
  - **Participation by India and China: less market share for Japanese buyers**
  - **Pricing on a more transparent and competitive basis**
  - **Flexible LNG acquisition ⇒ lower storage costs in internal markets**
- **Ship saving swaps to face uncertainties from seasonal demands and competition**
- **Market for Third-Party LNG Traders**
- **LNG more competitive ⇒ Allow more freedom of choice for fuels and suppliers**

Grid Interconnection

- Efficient energy system with stable supplies and linked to the Asian continent
- Northeast Asian Gas and Power interconnection proposed
- No. 1 characteristic of interconnection: externalities
  ⇒ system security, supply reliability
  - Well-coordinated transmission protocol/ pooling arrangement required
  - Harmonized institutions and industrial structures required
  - E.g., Lack of PSA rules ⇒ delay of gas development in Far East Russia

Grid Interconnection

- Policy risk, country-specific risk, cross-border risk to be minimized to invite private capital
- Cost-benefit assessment necessary for interconnection via North Korea considering
  - Not only transmission of energy
  - But also integration of power and gas systems, and
  - Inter-Korean relation